Benthic Food Web Analyses of Mercury Bioaccumulation in the Great Salt Lake

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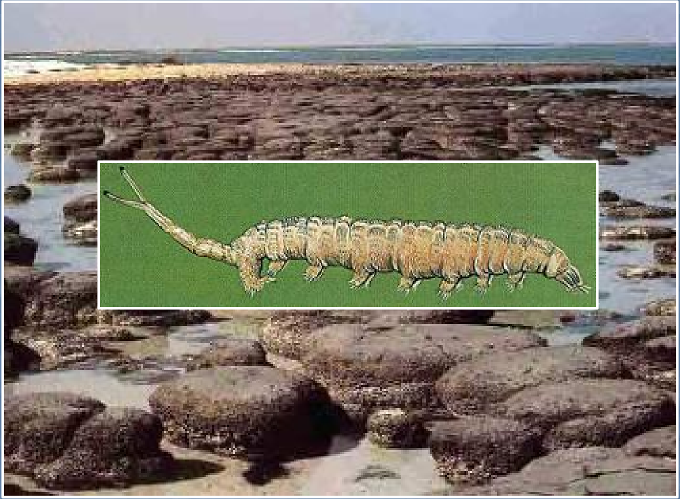
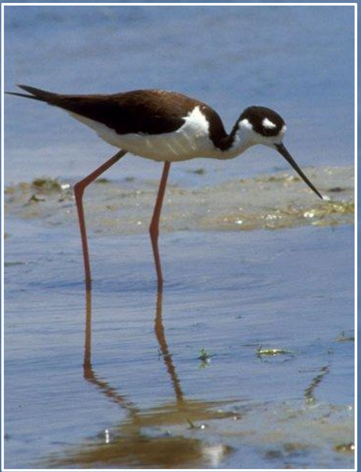




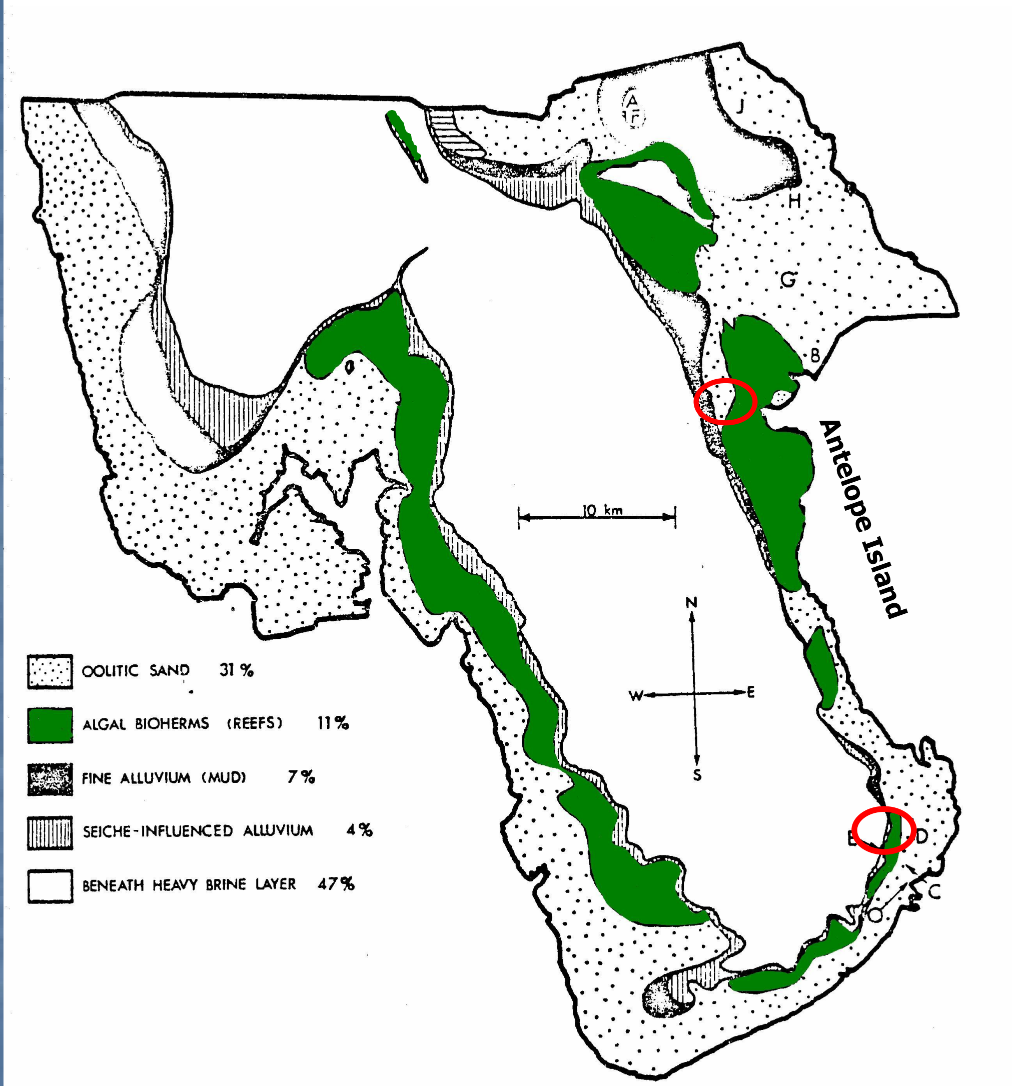
Objectives

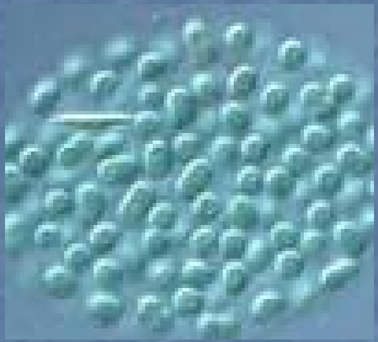
- **Describe the seasonality of brine flies and periphyton in benthic habitats of Great Salt Lake**
- **Collect brine flies, periphyton and water samples for mercury analyses in the food chain leading to birds**

Stromatolites

Dominant hard substrate for periphyton, brine fly larvae & pupae

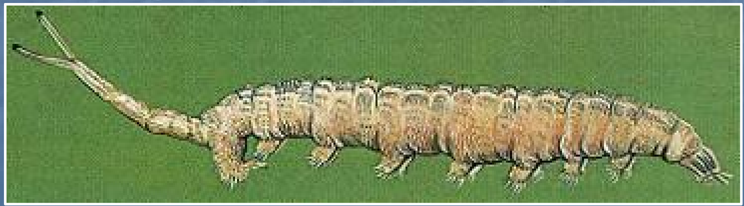
Distribution in Gilbert Bay





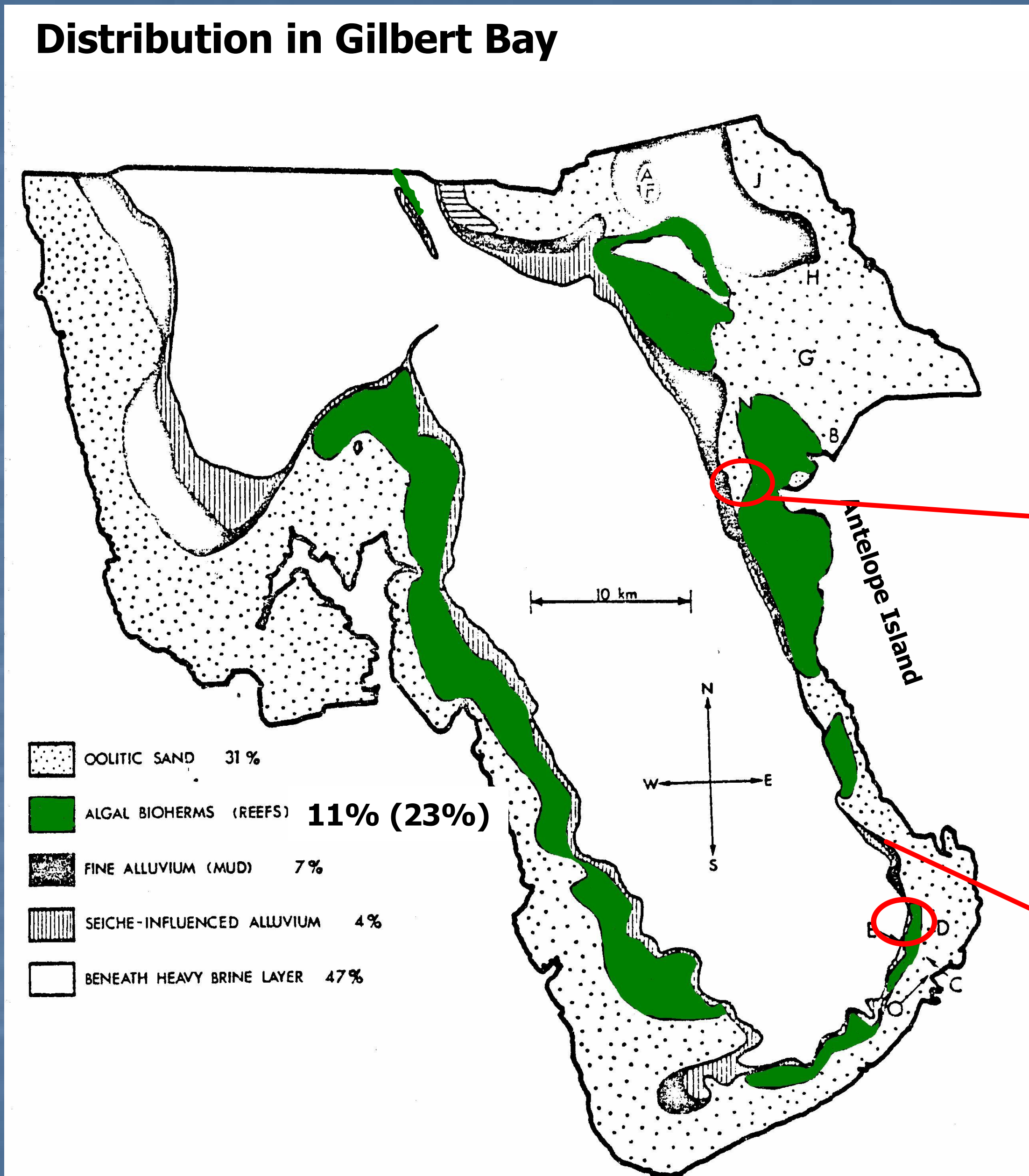
Aphanothece sp.
(cyanobacteria)

Food Web Importance:
Principal Brine Fly Habitat



Ephydra cinerea

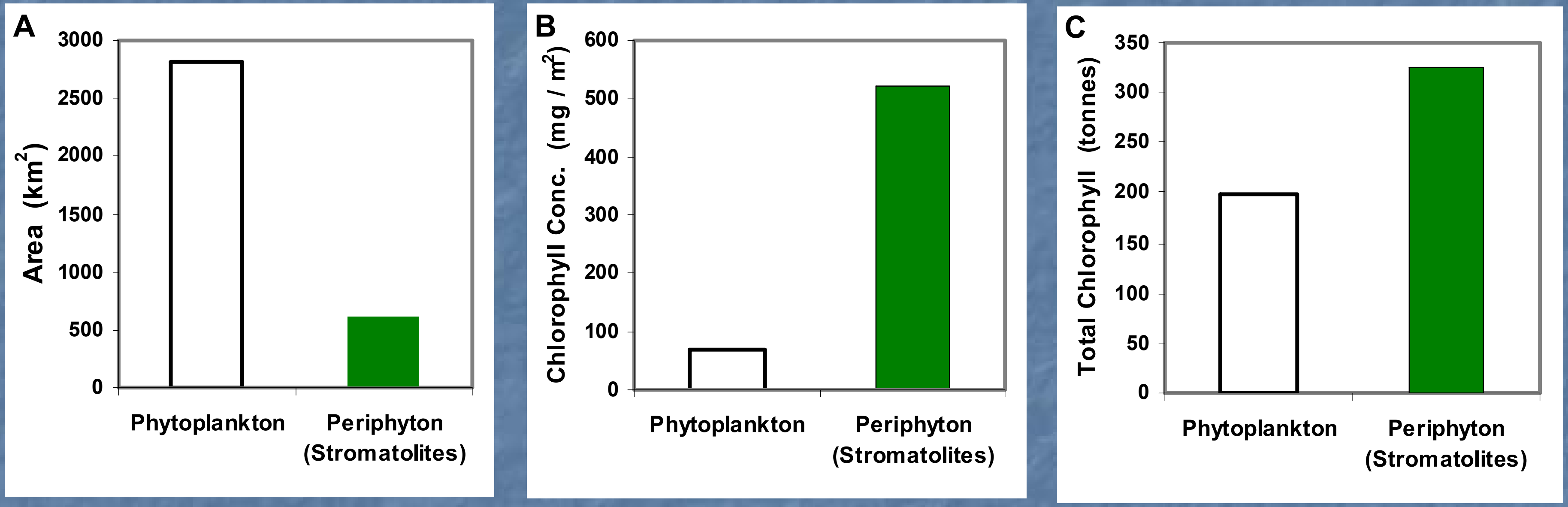
Stromatolite Structures



Flat, plate-like

Mounds, ca. 1-m high

Abundance of Periphyton on Stromatolites Compared to Phytoplankton



Periphyton on stromatolites is a very important component of primary production for Gilbert Bay

*Based on May-October phytoplankton in Gilbert Bay (2002-2005), and summer periphyton values

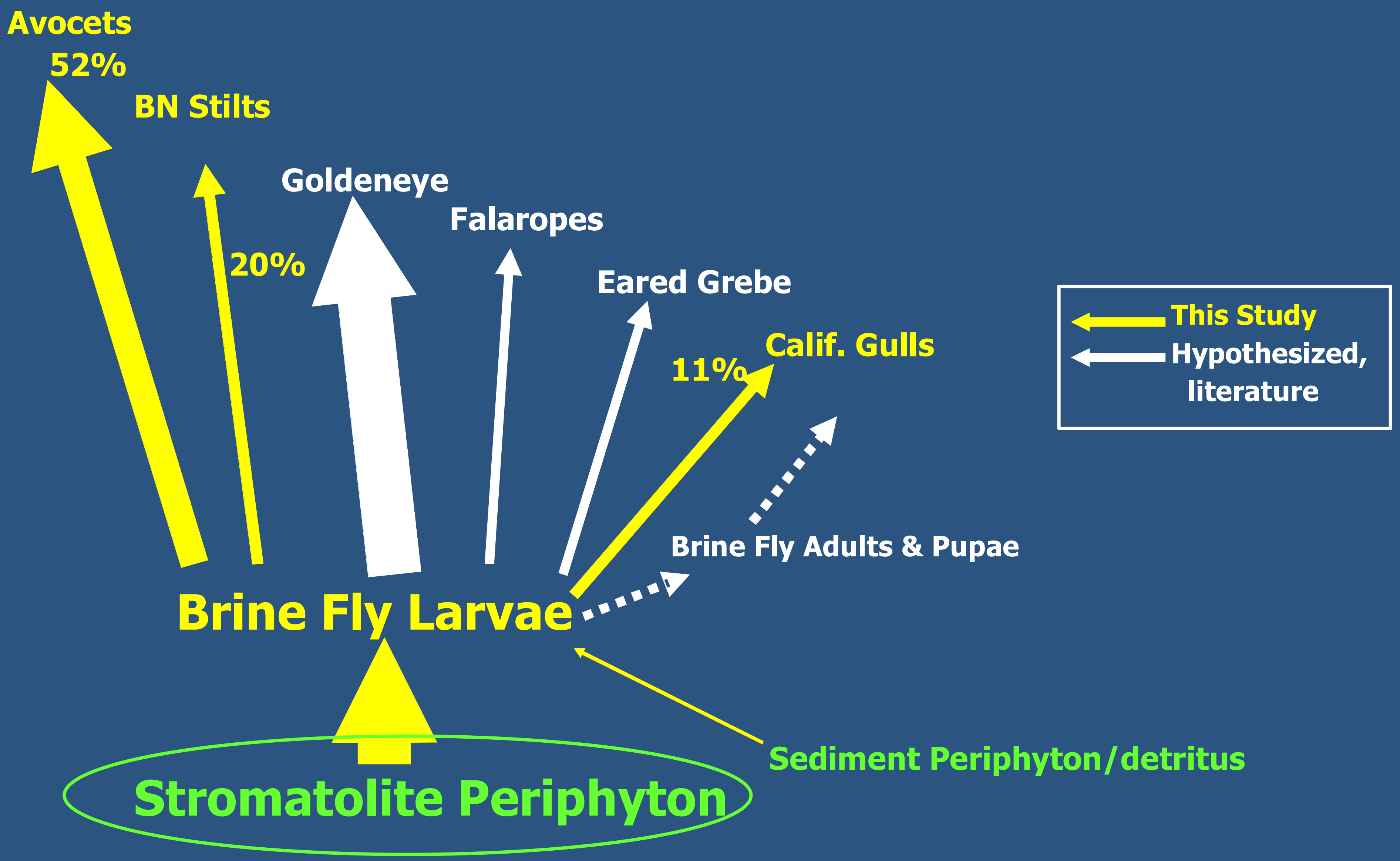
- **Benthic Community poorly studied and poorly understood (Collins 1980)**

- **Potential food resource for brine shrimp**

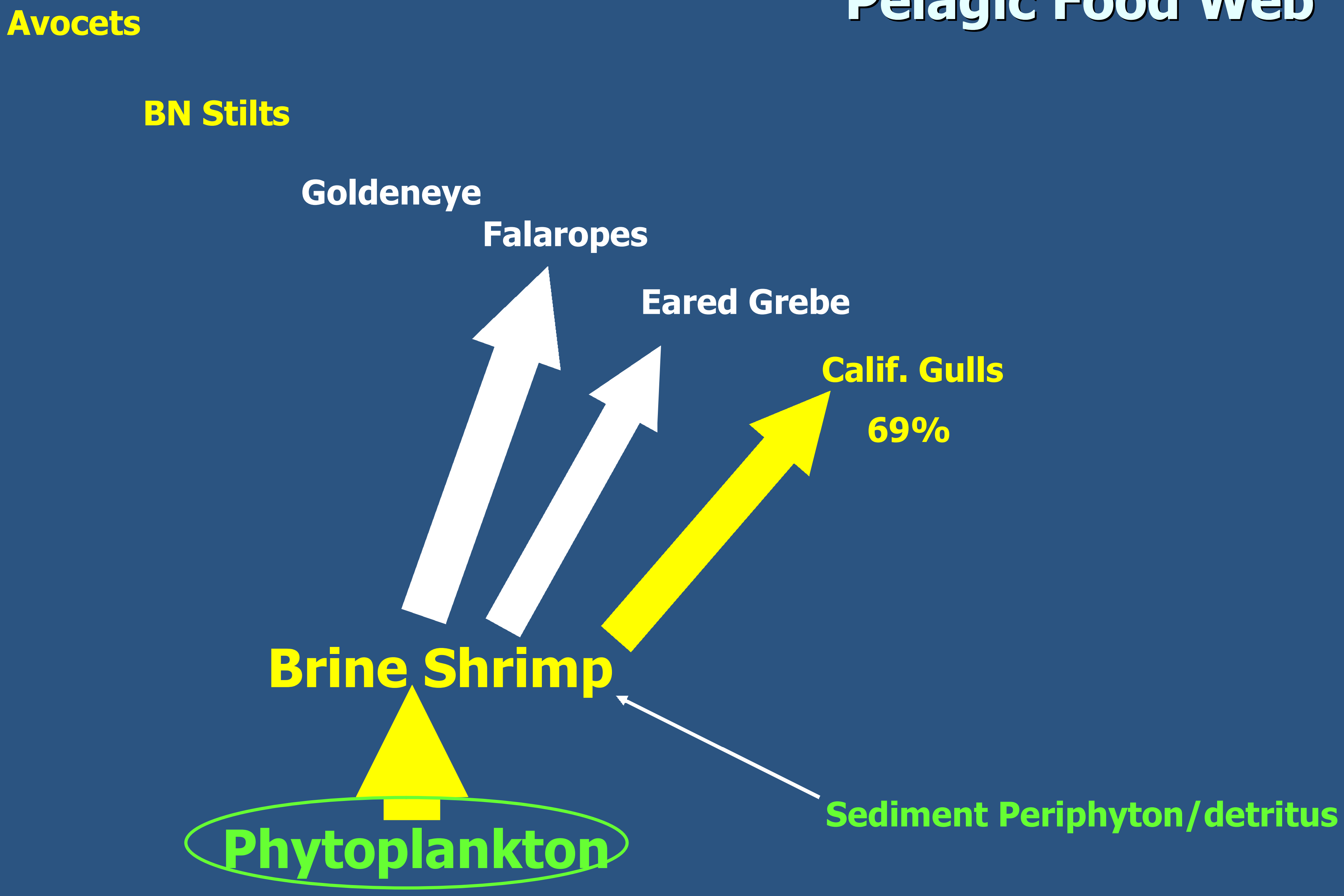
epibenthic grazing

- **Methylation of mercury occurs primarily in the benthic zones of lakes**

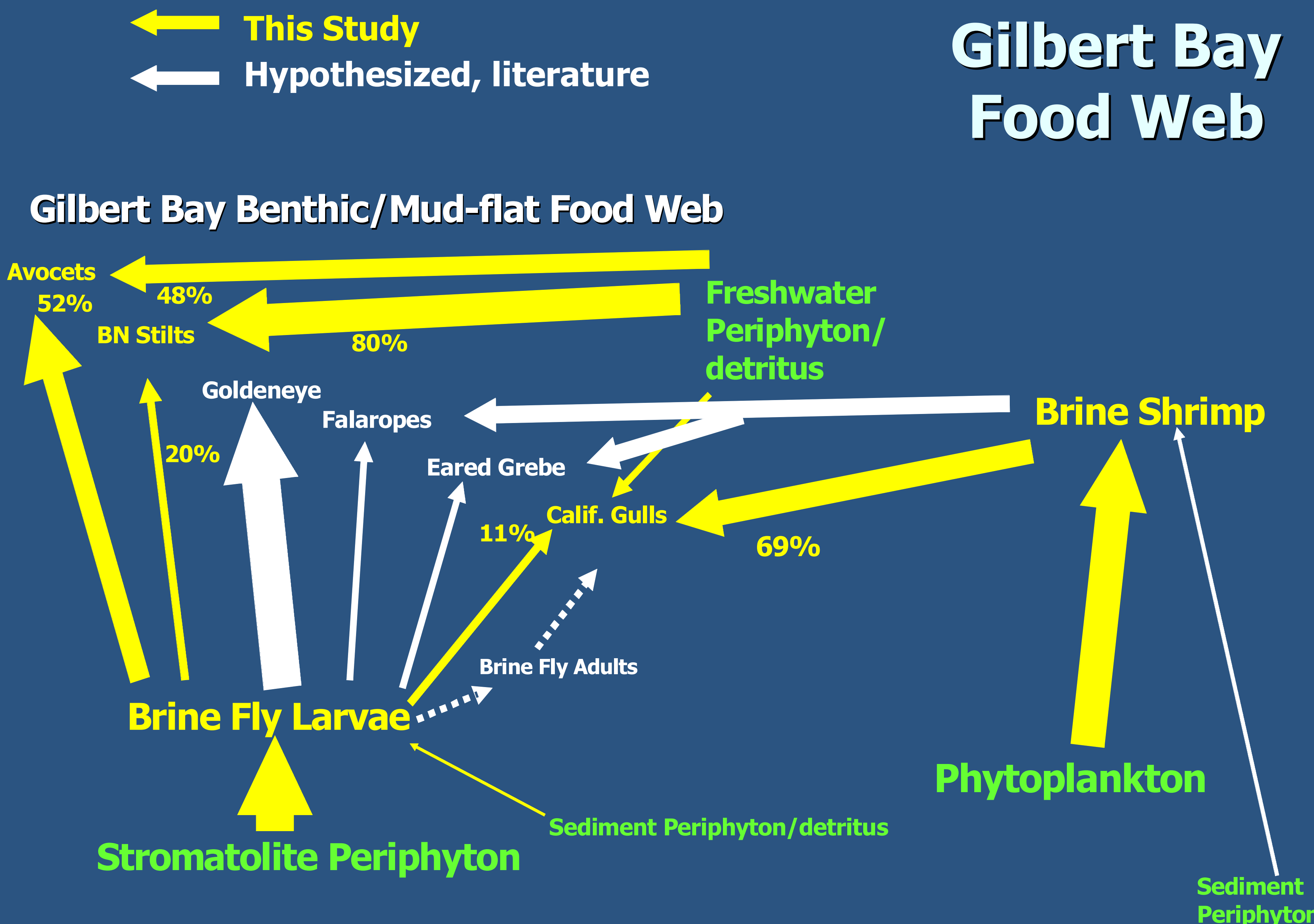
Gilbert Bay Benthic/Mud-flat Food Web



Gilbert Bay
Pelagic Food Web



Gilbert Bay Food Web



Proposed Sampling

- **Stromatolites**
- **Sand substrates**
- **Mud substrates**

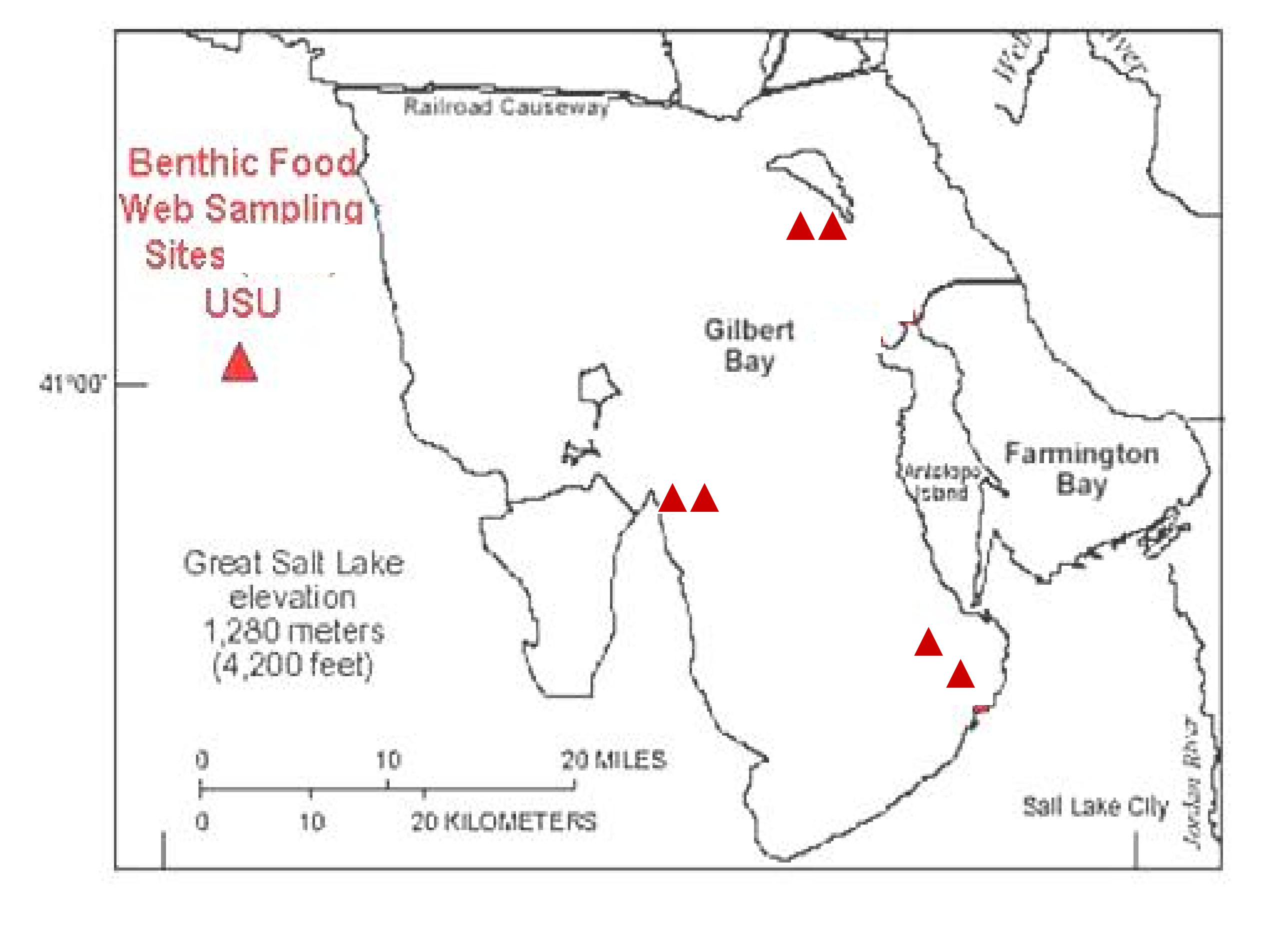
- **Food web components**

  - periphyton
  - brine fly larvae, pupae

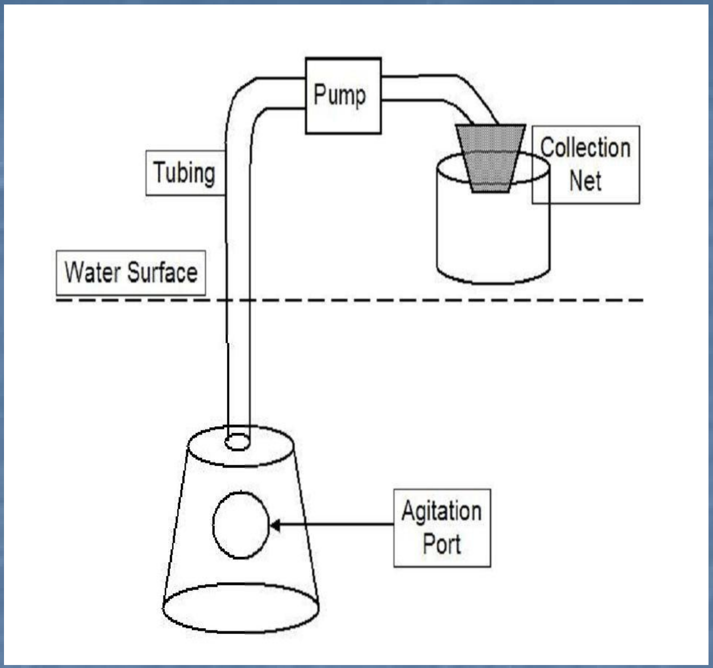
- **Nominal Depths**
  - 1 m
  - 3 m

- **Stations** (3)

- **Dates**
  - September
  - October (late)



Stromatolite Sampling Methods



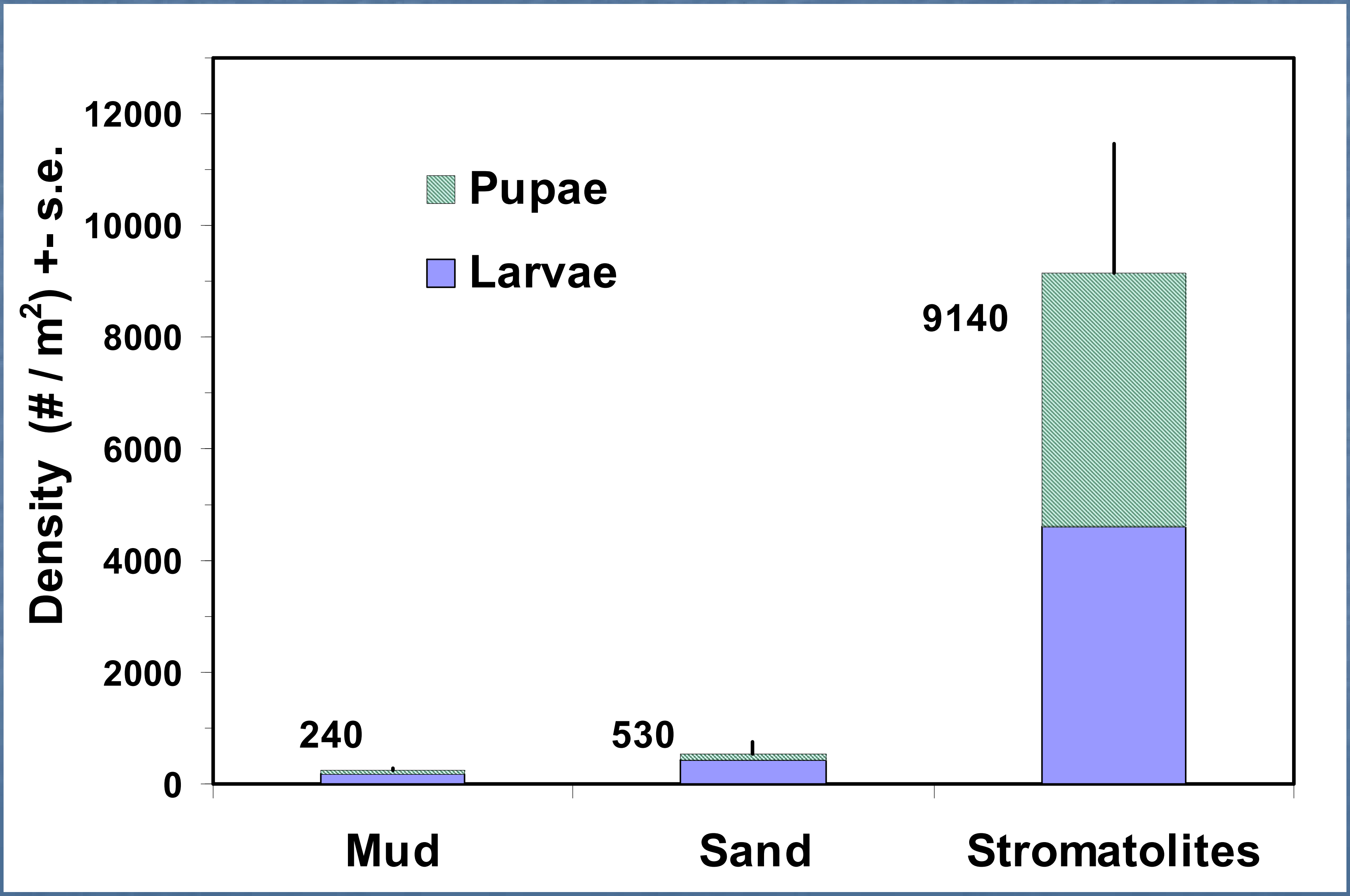
– **Brine fly larvae & pupae:**
  Bucket Sampler & SCUBA
  Scrub stromatolite surface with brush

Sample pumped to boat & sieved

Stromatolite chunks broken off underwater

- **Chl *a* extracted**
- **Ash-free dry mass determined**
- **Periphyton removed**
  - **With & without acidification to remove carbonates**
  - **Se measured**

Substrate Summary: All Sites

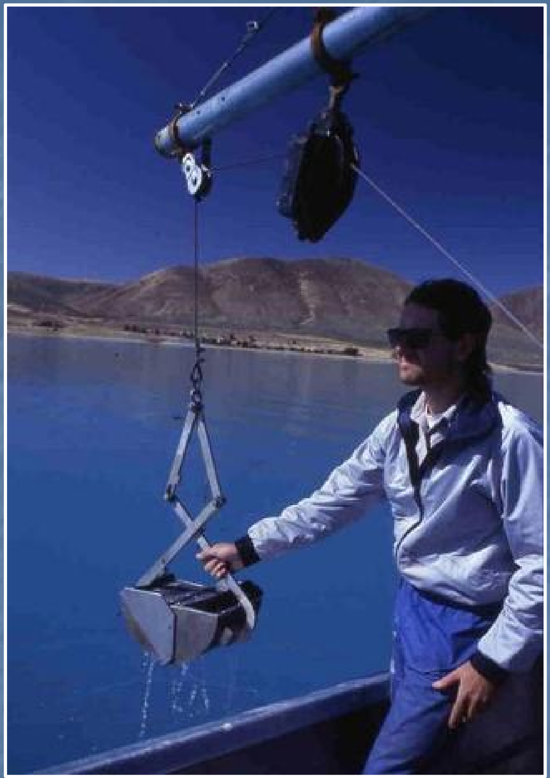



Questions?

Future Sampling – How Many Samples Are Needed?

Parameter	Mean	s	s^2	t_{95}	Sample Size Needed (n) With Allowable Error (L) of: 10%	20%	30%	40%
Larval abundance - sand (#/m^2)	256	316	99811	2.37	852	213	95	53
Larval abundance - stromatolites (#/m^2)	5240	4013	16105080	2.37	328	82	36	21
Organic Matter Sand (%)	0.062	0.029	0.00082	3.18	216	54	24	13
Organic matter stromatolites (%)	0.580	0.030	0.00089	2.45	2	0.4	0.2	0.1
Chlorophyll on stromatolites (mg/m^2)	698	207	42849	2.45	53	13	6	3
Se Concentrations larvae (μg/g)	1.20	0.26	0.066	3.18	47	12	5	3
Se Concentrations pupae (μg/g)	1.33	0.23	0.052	3.18	30	7	3	2

Methods



Soft Substrates

- Ponar dredge
- Sectioned (if intact)
- Sieved on boat

Methods

Water Samples

- Collected by SCUBA divers with syringe ca. 2-5 cm above substrates

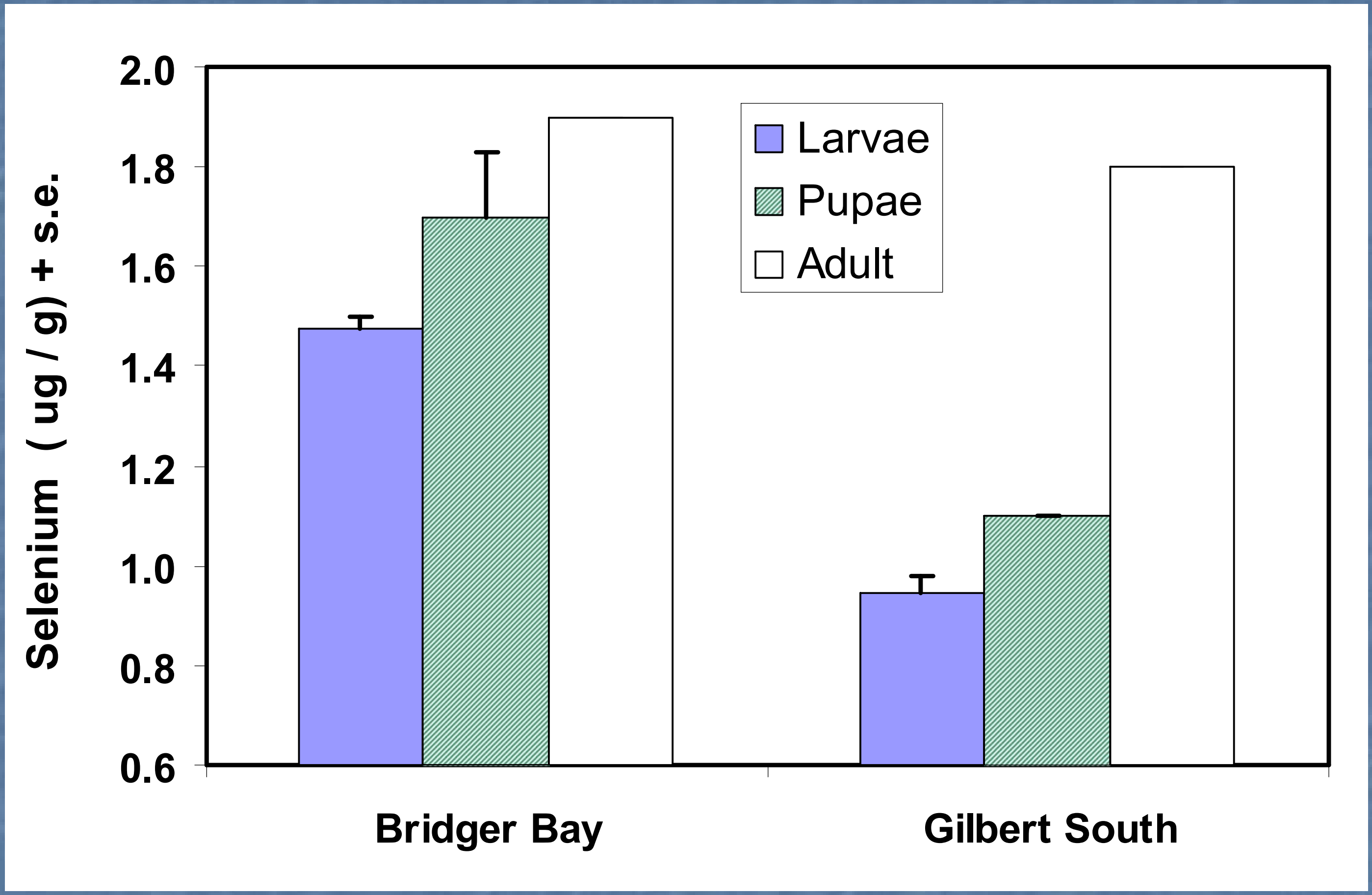
- Filtered with GF/F cartridge filter on boat & preserved with nitric acid

Methods

Adult Flies

- Netted over water or on shore
- Frozen on dry ice
- Rinsed with deionized water
- Dried, Se measured

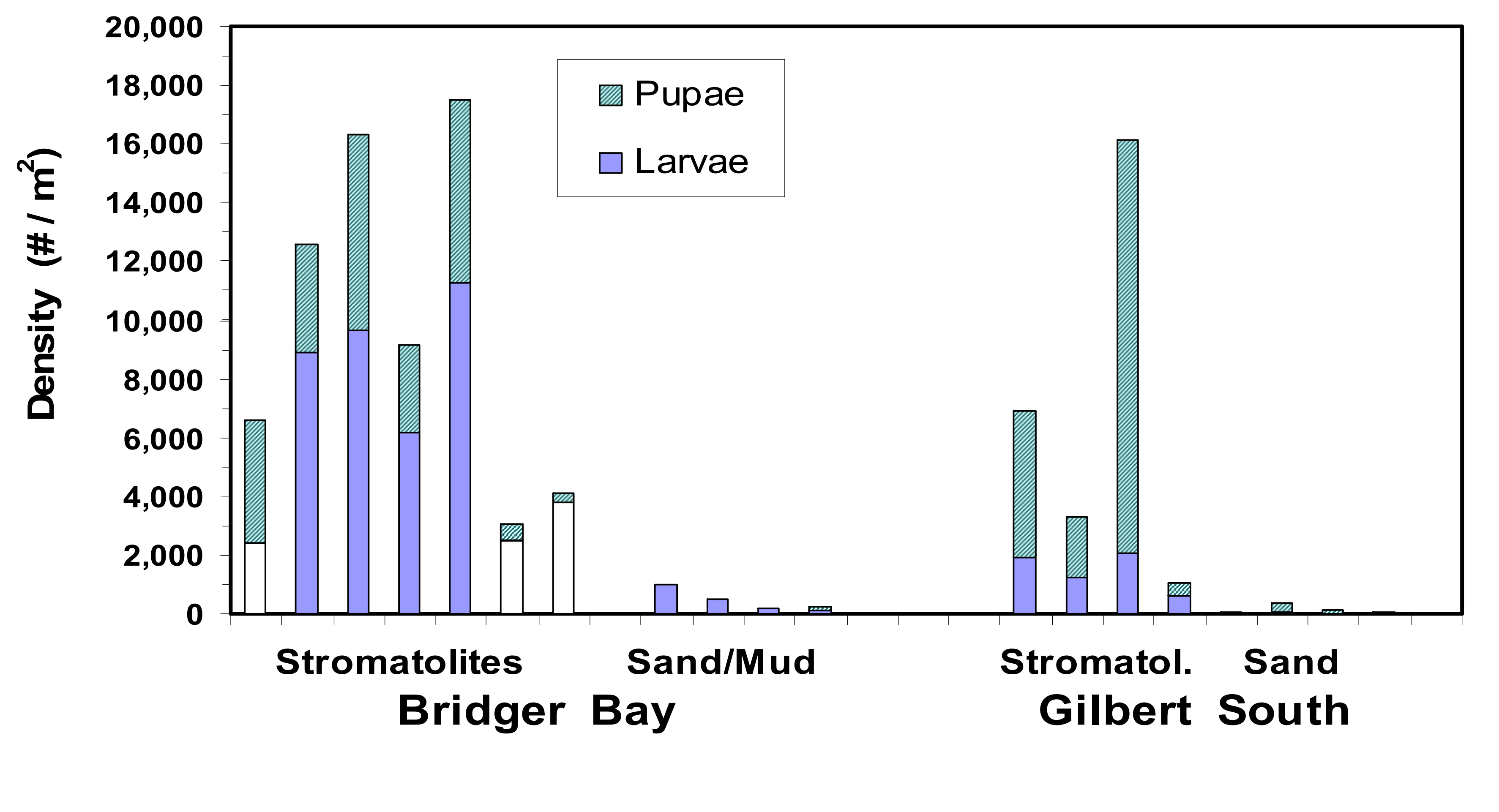
Selenium Concentrations in Brine Flies



Pupae > Larvae **p = 0.05**

Bridger > Gilbert South **p = 0.00**

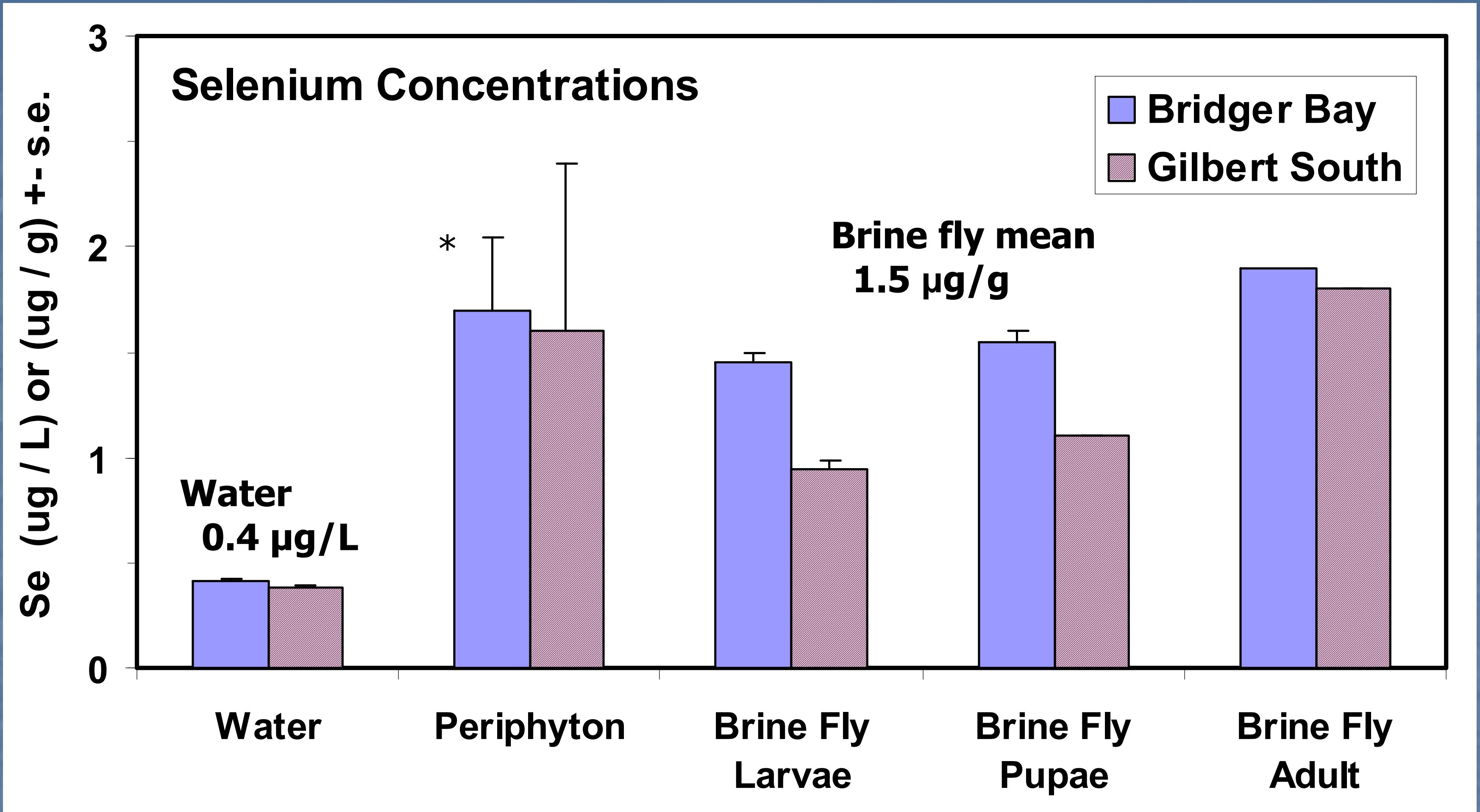
Brine fly: Larvae & Pupae Densities



Collection Site: Larvae - $p < 0.015$

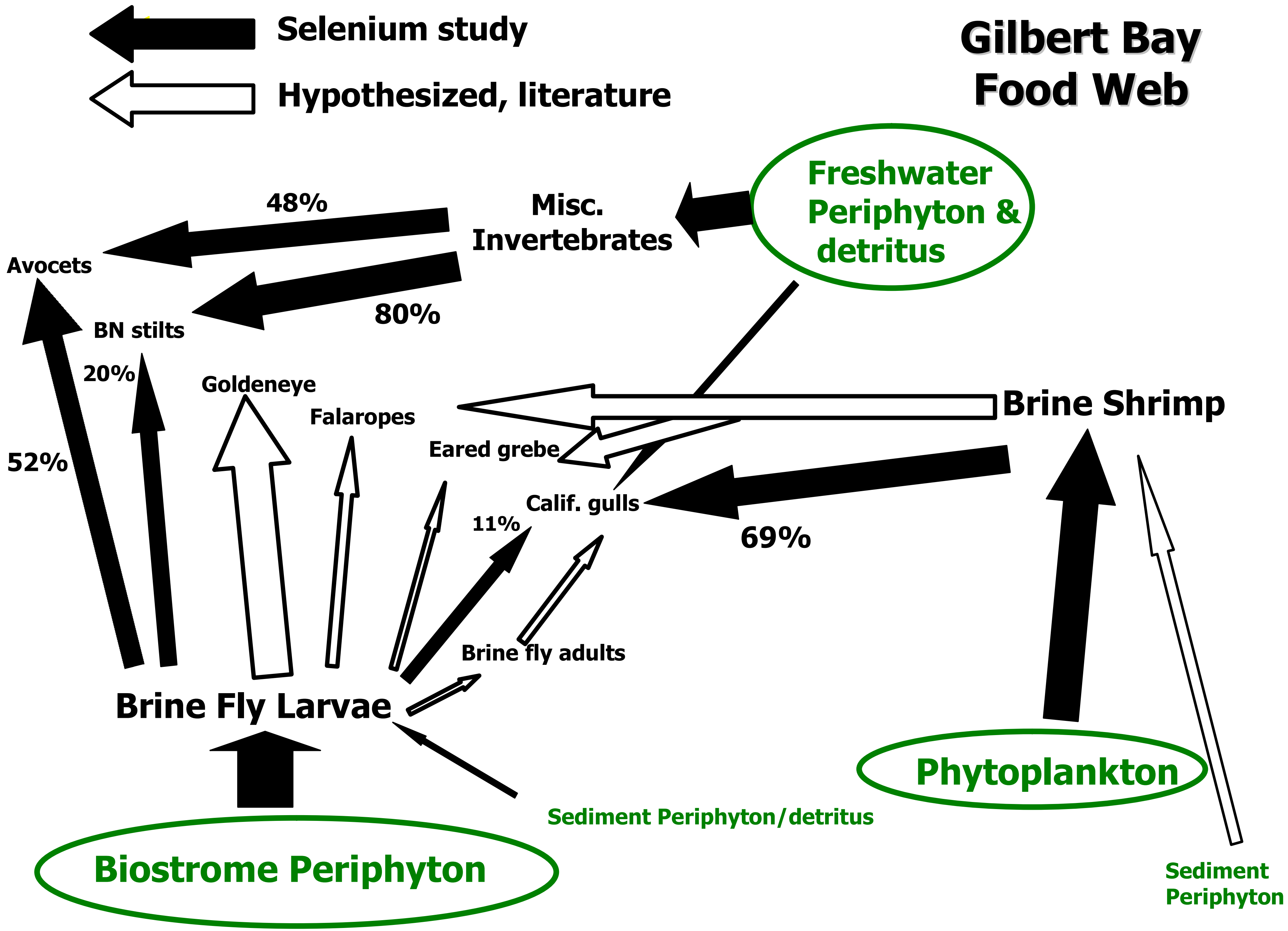
Substrate: Larvae & Pupae - $p < 0.003$

Selenium Data



This preliminary data suggests that there is no biomagnification of selenium in the food web

* One outlier removed (9.8 µg/g)



Selenium study
Hypothesized, literature
Gilbert Bay
Food Web
Freshwater Periphyton & detritus
Misc. Invertebrates
48%
80%
Avocets
BN stilts
20%
52%
Goldeneye
Falaropes
Eared grebe
Calif. gulls
11%
69%
Brine Shrimp
Brine fly adults
Brine Fly Larvae
Sediment Periphyton/detritus
Phytoplankton
Biostrome Periphyton
Sediment Periphyton

Conclusions

- **Stromatolites/periphyton and brine flies are important in the economy of the lake, and important in the diets of many bird species**

- **Sampling technique for brine flies is effective but:**
  - **limited to horizontal surfaces: does not work well on sides of erect stromatolites**

- **Brine fly larvae and pupae densities approximately 20 X higher on stromatolites than mud and sand**
  - **Greater areal extent of mud and sand, however, means that these habitats are also important areas of brine fly production**

Conclusions

- **Statistically significant higher concentrations of Se in larvae & pupae at Bridger Bay site than at Gilbert South site.**
- **Selenium concentrations are low in:**
  - **Overlying water (0.4 µg/L)**
  - **Periphyton (1.7 µg/g)**
  - **All life stages of brine flies (1.5 µg/g)**
- **There was no biomagnification within the short benthic food web**

Conclusions

- **Stromatolites (biostromes) and brine flies are the least-well understood component of the food web in the Great Salt Lake and more work is needed in this area.**